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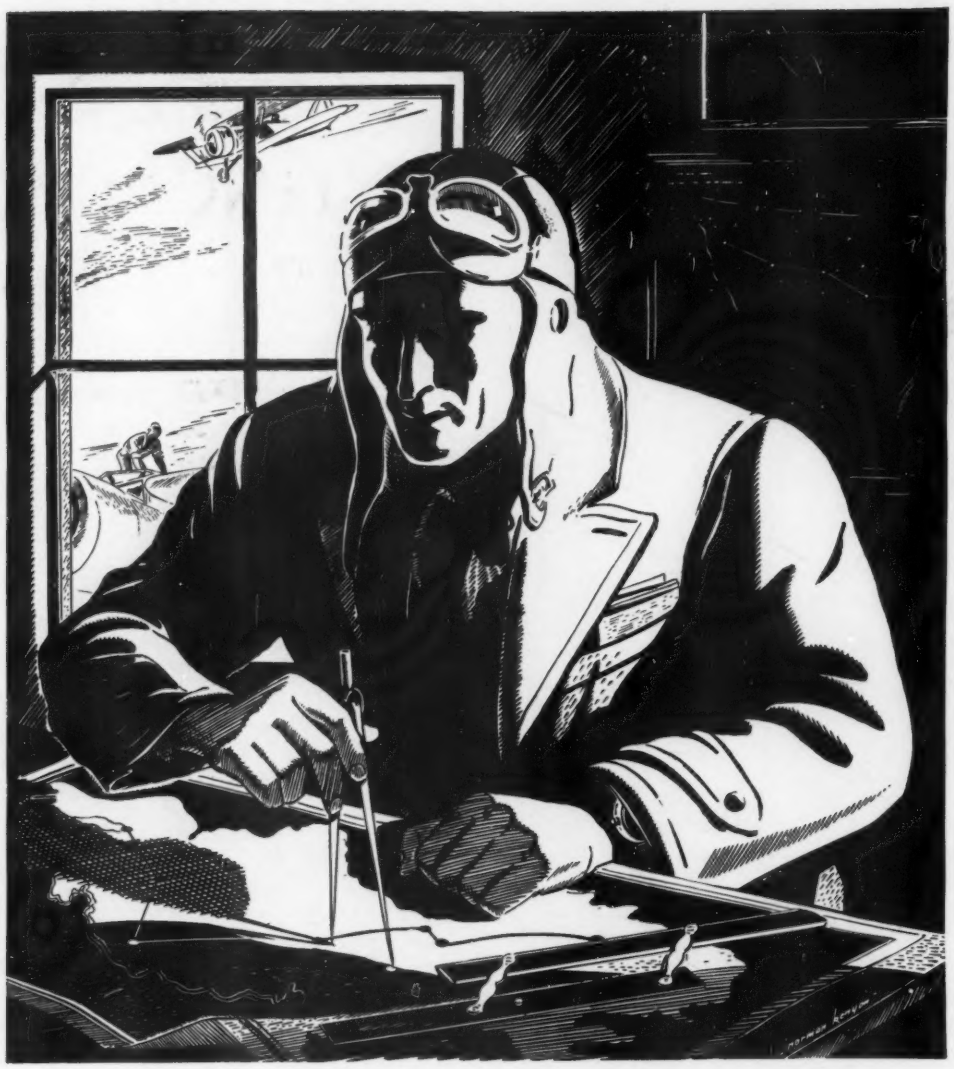
MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

MASSACHUSETTS
INSTITUTE OF
TECHNOLOGY

VOLUME XIII, NO. 2
MARCH, 1932



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Technology Branch

H · C · S

PREVIEW

ONE of the most fascinating stories to which the human race is heir is the story of its own development. Prof. Frederick K. Morris, of the Department of Geology, knows this story from the viewpoint of the geologist. As a hobby he has inquired into the story as other scientists, the astronomer, the biologist, and anthropologist, see it. The result is a comprehensive picture such as few have had the ability to construct. It is therefore a great privilege to be able to present herewith the first of a series of three articles in which Professor Morris tells the story of the origin of life, as he sees it. Professor Morris is one of the leading scientists in America, and his interpretation of the story of life is therefore one of authoritative and mature judgment.

THE engineer is finding that his brand of thinking can be used effectively in many pursuits once thought to be outside his sphere. Now it appears that the remote field of finance offers opportunities to the engineering graduate. Mr. William I. McNeill '17, who is General Supervisor of Cost Accounting of the largest soap manufacturing organization in the world, is one of those who have succeeded in this field. In his article he points out that accounting is a promising field for engineers. For more than ten years, Mr. McNeill has specialized in the accounting systems of manufacturing organizations, and he is therefore well able to show how the engineer's training fits him for executive positions of this type.

NEW YORK'S skyscrapers are a never-failing source of delight to the photographer. But the personality of each spire needs more than a camera for interpretation. In this issue, reprinted from *The American Architect*, are to be found two pages of pictures illustrating the architectural beauty of Manhattan's towers together with captions written by Charles Phelps Cushing, leading architect. These captions point out the personal element in each building with refreshing penetration.

WHAT is wrong with the present system of engineering education? Mr. Beaumert Whitton '33, Editor-in-Chief of *The Tech*, who is about as close to student affairs as any undergraduate at Tech, replies to this question from the student point of view, while Prof. Ernst A. Guillemin, of the Electrical Engineering Department, one of the outstanding lecturers in Tech, tells what can be done about it. Both of these writers are well qualified to speak for the groups they represent, and it is hoped that the discussion will bear fruit in the form of improved student-faculty coöperation.

A NEW department appears for the first time in this issue. It is designed to present, in tabloid form, the outstanding research and scientific achievements which have taken place in Technology during the month preceding its publication. Coincident with this department appear changes in typography which are evident to the discerning eye. The body type is now Scotch Roman, conceded to be the most readable of all book faces, while the headlines preserve the former tradition in a heavier style with a type known as Bodoni.

The TECH ENGINEERING NEWS

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Courtesy of Bell Telephone Laboratories

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THE TECH ENGINEERING NEWS

THE PROFESSIONAL JOURNAL OF THE UNDERGRADUATES OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

VOLUME XIII — MARCH, 1932 — NUMBER 2

The Story of THE EARTH AND ITS CREATURES *— A Scientific Essay*

By Frederick K. Morris
Professor of Structural Geology
Massachusetts Institute of Technology

Part I: FROM SUN TO CELL

THE structure of growing knowledge is like the building of made-land along a seashore. Based upon the solid *Known*, men toil against the very verge of the chaotic *Unknown* — now filling in the shallows with but little difficulty, now building perilous breakwaters, dikes and groins in stormier seas, now establishing an isolated pile of truth like an island, and then sounding and bridging the depths between the larger mainland and the island of discovery. The fringe of knowledge aims to advance as an even front, replacing the sea of ignorance. But some of the waters are as yet too deep for us, and our workers are not equally distributed on all the coasts, nor are they equally equipped. And so, partly because of the inherent topographic difficulties of the sea itself, and partly because of the number, the means and the genius of the builders, the growing font of knowledge is a complex web of construction — some of it solid as the mainland, some still on piles, some tenuous falsework looking to be removed when more permanent structures can be built; and here and there, mere soundings are dropped into the deep waters.

Backrack

In this picture there is no place for speculation. Even the soundings require daring, skillful mariners; and the easy-chair philosopher is free to cogitate, and welcome to his feather-and-inkhorn as of old. But he doesn't belong to the union.

Our forefathers in this building trade of science have left us a broad foreland "stretching far through seagate, dike and groin — made-land all — that our fathers made, where the flats and the fairway join. They forced the sea a sea-league back. They died, and their work stood fast." We work outward from their shore, and are broadening the salient peninsula of astronomy to join with the detailed studies piled by the geologist and biologist, who can handle their subject matter, while the astronomer can only see his.

The geologist can confidently tell the history of the earth for thirteen to fifteen hundred million years. The biologist can confidently show a record of living creatures, preserved as fossils, extending through about half of the geologist's time scale. What is each record like, as it passes the bounds of our vision, and is lost in the deeps of the sea of ignorance?

The oldest preserved undoubted animals, whose fossils have come down to us, lived about seven hundred million years ago. But they were complex, specialized creatures, belonging to groups that exist today; some had shells, some had skeletons. There were sponges, corals, molluscs, brachiopods, worms. This wide diversity of living things clearly proves that evolution had been at work a tremendously long time. Our sounding of this deep of ignorance tells us reliably that life had originated enormously long before those first fossils of complex, advanced, specialized creatures had been enclosed in the rocks.

And when we turn to the vanishing-point of the geologist's record of rock strata we find among those earliest rocks, now changed to glittering crystalline schists, gneisses and marbles — rocks that originally were muds, sands, and beds of limestone; volcanic ash and lava flows, and pebbles laid by waves, streams, or even by the ice of glaciers. All of the deposits were exactly such as the earth is making today. The limestones, then as now, were chiefly the work of some kinds of living beings; and in the schists, which once were the muds of lakes and broad shallow seas, we find abundant graphite that probably is the carbon once contained in plants. Thus the last sounding which we may draw as a safe inference from the rock strata is that the earth was very like the earth of today — with lands and seas, slow deliberate weathering of its rocks, movement of large rivers, and the work of shallow, sunlit seas which teemed with life. The earth of that distant era was no hotter, no more volcanic, no cloudier with vapor veils, than the earth of geologically recent periods. Why can't the geologist read any further back into the earth's history? We might expect that he has only to look underneath those ancient rocks to find what they were

Editor's Note: This is the first of a series of three articles by Professor Morris on the subject of the development of life. The econd will appear next month.

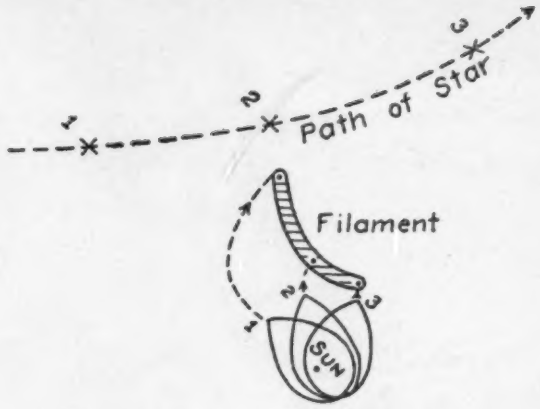
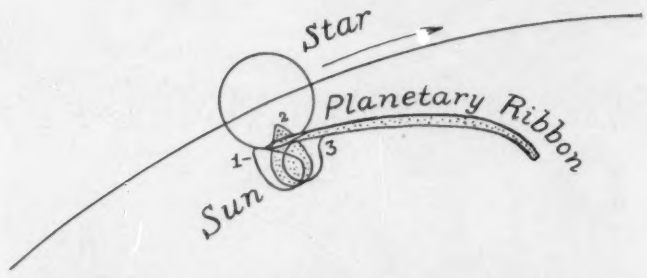


Figure 1. According to Sir James Jeans, the star passed by the Sun and drew out a single filament of material which collected into the planets.

Figure 2. According to Doctor Jeffreys, the star crashed through the outer portion of the sun. Its encounter lasted about an hour, though the relative velocity of the two bodies was at least 400 km. per second. The numbers 1, 2, 3, mark three positions of the sun; just before, during, and after the crash. The planetary ribbon contains abont 1/500 of the sun's mass, and its chief particles rotate as they travel out from the sun.



laid down upon; what older rocks underlie them; and, from the nature of those yet more ancient rocks, to read another billion years of history. There is no lack of exposed rocks, and no lack of zeal to read their story. But in all regions, there have been uprising hot molten juices at one time or another. The further into the past we search, and the deeper we examine the rocks, the more abundantly do we find these juices, now crystallized to granite. Not that granites formed more abundantly long ago than they do now — but that we increase their frequency as we lengthen the time record; and we uncover them more broadly as we study areas from which great thicknesses of overlying rock have been stripped.

Now these hot juices are very mordant, solvent, penetrating; and their uprising is actuated by mighty pressures. They can dissolve the overlying rocks as hot coffee dissolves lumps of sugar. So when we go backward into the ages, and see older and older rocks, lying each underneath the next younger bed, we come to where the last rock vanishes into the dissolving granite, and our *legible* history ends. It is just as though the history of the earth were written in a great book, whose pages are bedded rocks, and some mischievous child had torn out the first half of the book and burned it in the fire of granite, leaving us to begin our reading with the middle chapter.

When the legible chronicle of the existing rocks began, the earth was virtually mature; and before that time, an immense eon must have witnessed the history of the earth from the time when it was part of the flaming sun to the time when it was a mature, cool-surfaced planet, with one-celled plants and animals in its seas. This sounding at least is an inevitable inference; but it is a sounding of the deep sea of ignorance between geology and astronomy.

The astronomer tells us that all of the solar planets together would make only 1-750th of the sun itself. We rely upon the astronomer's determination of the size, mass, position, and movements of the sun and planets; and thus far we tread the good made-land that pushes back the sea of ignorance. The movement and size of stars and even their composition and structure are established — in some points very reliably, in others with fair likelihood of truth.

Speculation is ruled out; only inferences from known facts are admissible. Two classes of theories have arisen; one we may call theories of normal development, the other, theories of accident or catastrophe. We have heard that the solar system developed from a gas nebula, by contracting and revolving and so detaching planet rings about its equator. We have heard that the solar system arose from a flight of meteors, which, overtaking and coalescing with one another as they whirled about the central mass, grew into planets. These are theories of "normal development," and, for good physical astronomical reasons, they must be discarded.

Two chief "theories of accident" have arisen. One supposes that another star went past our sun long ago; that the two great bodies pulled one another with ever-increasing tides as they approached, until the stuff that makes the planets was dragged out of the sun, out to the distance of Neptune, or farther if there be another planet beyond Neptune. The other theory supposes an even more terrific catastrophe — that the passing star *struck* the sun a glancing blow, side-wiped it, and peeled off a long ribbon of stuff from the sun. The pirate star swept on, dragging the ribbon after it and giving a

(*Continued on page 40*)

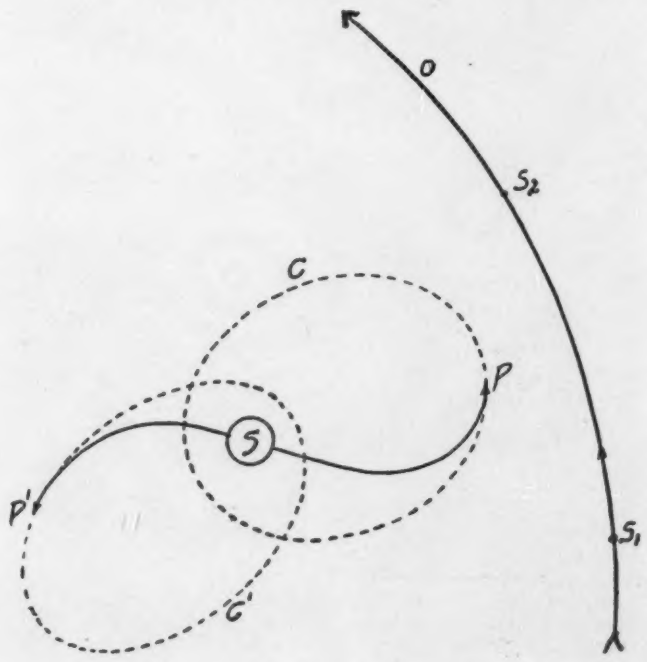


Figure 3. According to Professor Chamberlin, the star passed the sun at a distance greater than the orbit-distance of Neptune. It pulled out two tidal-filaments, and imparted a somewhat orbital movement to the particles.

Accounting—
A NEW AND PROMISING FIELD
for Engineering Graduates

By William I. McNeill '17
General Supervisor of Cost Accounting
Colgate-Palmolive-Peet Company

AN engineering education to many people is about as sensible a background for a professional accountant as for a minister of the gospel. To others, the accounting profession may even seem a restricted and narrow path to business greatness. The purpose of this article is to point out the very real opportunities in the accounting field for engineers with accounting fundamentals acquired through a commercial engineering course such as Course XV or through any other recognized school.

In looking forward to a professional life in any field the student naturally asks:

1. What is the executive position toward which to shoot?

2. What is the best road to take to develop the requirements of the job?

The positions of assistant comptroller, comptroller, and vice-president in charge of finance are worthy goals for attainment in the accounting field before aspiring to higher responsibilities. The development of any normal individual into an executive takes place on a sliding scale. First, to get a start, education, personality, etc., plus some little knowledge of a particular field are all that is necessary. In the next steps specialized knowledge predominates. Common sense, coöperation, and organization ability have not yet come into full play. As the jobs approach the top or goal, the need for specialized knowledge decreases and the qualities of common sense, good judgment, ability to coöperate with others, and organization ability are foremost. Specialized knowledge in pure accounting is fairly plentiful on the market but the other requisites of a real top-notch position, common sense, judgment, etc., are at a premium. In starting out therefore, it is well to have in mind these necessary qualifications for a real position so that they may be developed along with specialized knowledge in the beginning jobs.

The main road leading to comptroller or vice-president in charge of finance may be approached by several branches of which the following are the most important.

1. Public accounting.
2. Credits — billing and accounts receivable.
3. Cost accounting and statistics.
4. General and home office accounting.

The public accounting field offers a very good chance for the embryo accountant to follow up his studies with junior accounting work. A year or two spent in auditing work fixes text book principles concerning balance sheets, profit and loss statements, and general books of account in the mind of the beginner and shows him how to detect faults in the figures which show a company's financial position. The line of advancement is from junior to senior accountant and perhaps later to the managership of a district office. To a person who does not care to remain in this field it offers a very good chance to observe different concerns at close range with a view toward finding one which might offer employment. This is discouraged to some extent by public accounting firms, but on the other hand it very often gives them an outlet for their good men whom they cannot take care of in their own organization. This fact attracts really good men to the public accounting field.

Business houses very often use public accounting concerns as they would an employment agency in order to get men for their organization who have had a few years public accounting training. This training is of a general nature and is admirably suited in developing men for general accounting work, preparation of balance sheets, profit and loss statements, etc. A successful comptroller must however know more than general accounting: he must know the business he is in thoroughly before he can approve an accounting system to fit the needs of the business. One of the severest criticisms which accounting as a profession has to stand is the history of accounting systems installed at great expense with high hopes of furnishing control which will actually justify itself in dollars and cents, only to find that it was ill-adapted to the business, added red tape, and confusion, and had to be thrown out.

Many manufacturing executives view an accounting system with contempt because the accountants who install and operate it cannot talk intelligently about the various operating problems. This is particularly true of an intricate mechanical or chemical business. It is the writer's opinion that in order to intelligently judge the accounting problems of a business, a comptroller should know the details just about as thoroughly as the manufacturing executives. If this is true, the engineer has the fundamental background on which to build. Hence, after one or two years of public accounting, it is well for the engineer who wishes to get into a manufacturing business to obtain a position which will give him a fundamental knowledge of the business. The department best qualified to furnish a start will be indicated later.

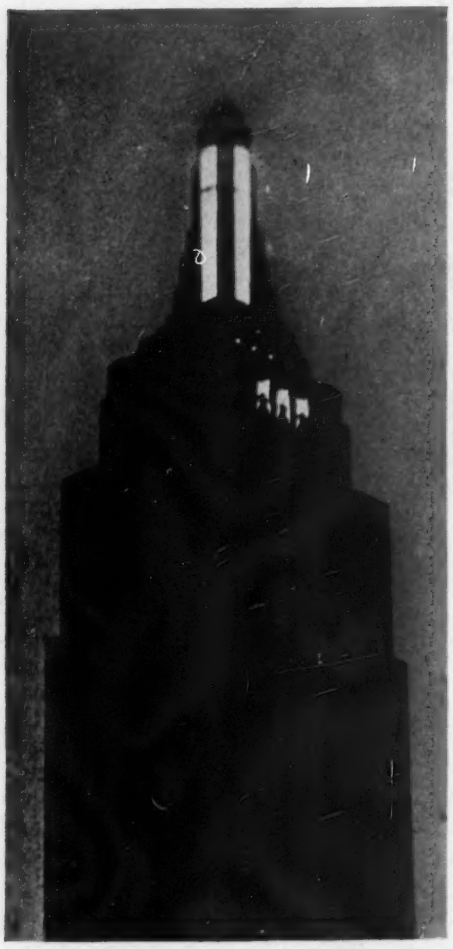
The second branch of the road carries one into that part of the accounting organization which receives orders from the sales department, transmits orders to the warehouse, invoices the customer, determines the buyer s credit, keeps accounts receivable, and answers customer's complaints.

This branch is one in which there is much clerical routine but which involves only very simple accounting procedure. The principal problems in this part of the organization are to see that the work flows smoothly, is accomplished daily, and that an efficient clerical force is maintained. It is recommended that the engineer pass up this department until he needs a knowledge of it to round out his training. If such is the case its routine can be easily mastered in a few months.

The third section of the accounting organization is

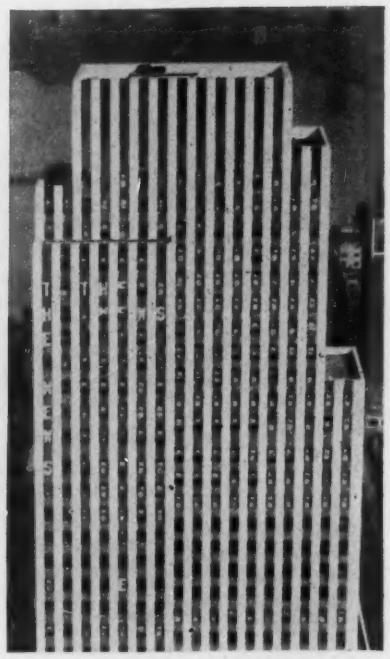
(*Continued on page 39*)

THEY REMIND ME

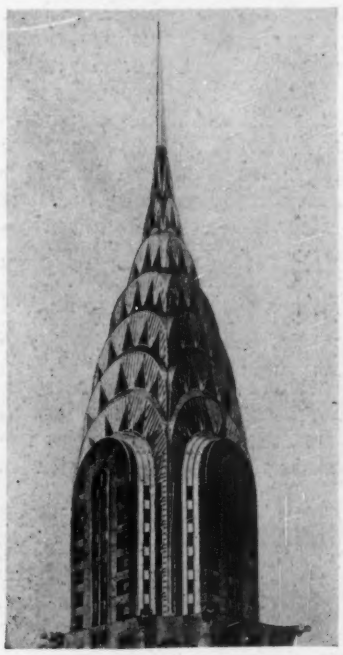


A Candlestick, the like of which the world has never seen before, is the Empire State Building by night. The tip of it reaches 1250 feet, the equivalent of 102 stories. The trimmings are sterling silver in vertical bands. What a job that will be for silver polishers!

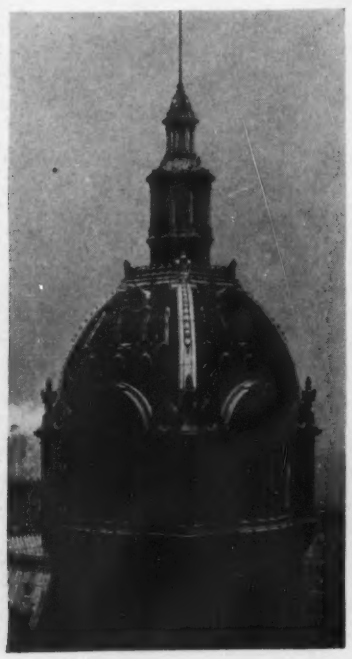
Pyramid from Yucatan is our Jazz Age challenge to the Pre-War Era's Bankers' Trust pyramid. The Equitable Trust's top seems to me to be Mayan. But possibly I'm wrong: "it may an' it mayn't be Mayan!"



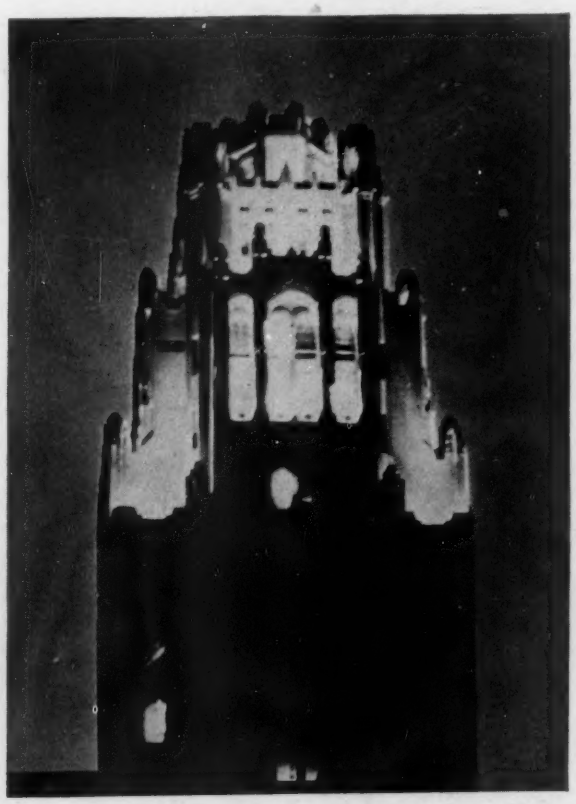
Stack of Tabloid Newspapers thirty-six stories high is the Daily News Building. Paul Bunyan, the North Woods hero who fells trees for pulp mills, stacked up these newspapers in his spare time.



Giant Asparagus Stalk done in the modernist fashion is the dizzy spire of the new Chrysler. This sets a precedent which soon may enliven our skyline with all kinds of interesting and colorful fauna and flora.



Hard Coal Stove, a sixteen-jeweled "base burner," is the Singer Building's top. I never can look at it without thinking of long winter evenings in the sitting room of a cottage way back home in Missouri.



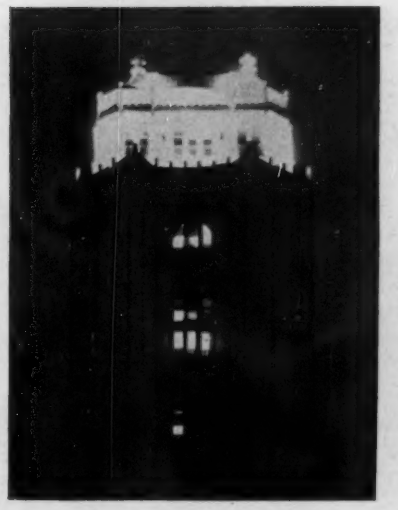
"A Pile of Coal, Glowing at the Top," is the architect's own account of the symbolism of the American Radiator tower. But to my eye it isn't a coal pile. It's a mammoth black and gold steam radiator.

OF . . . . .

A Layman's Fantasy of the TOWERS OF NEW YORK

Photographs and Text by
CHARLES PHELPS CUSHING

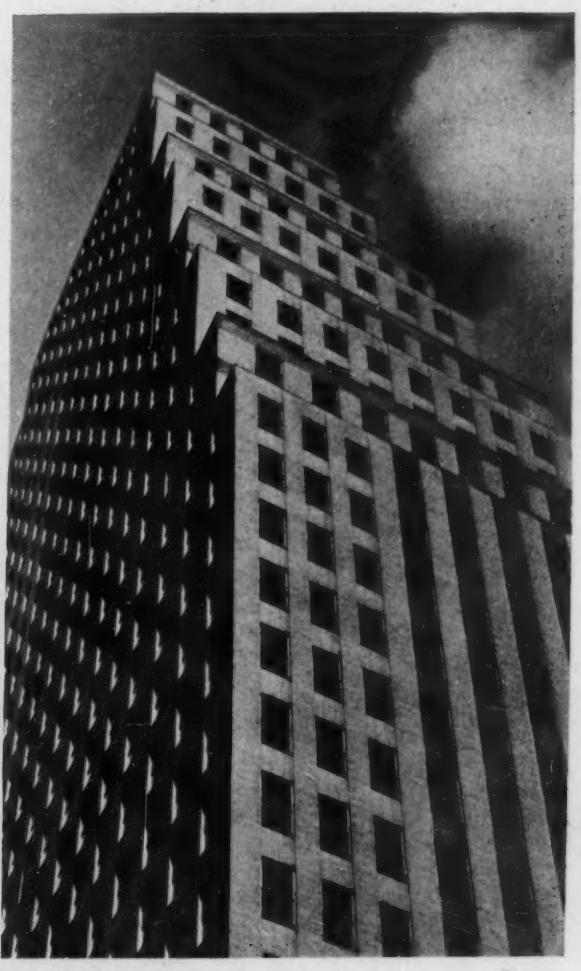
Courtesy *The American Architect*



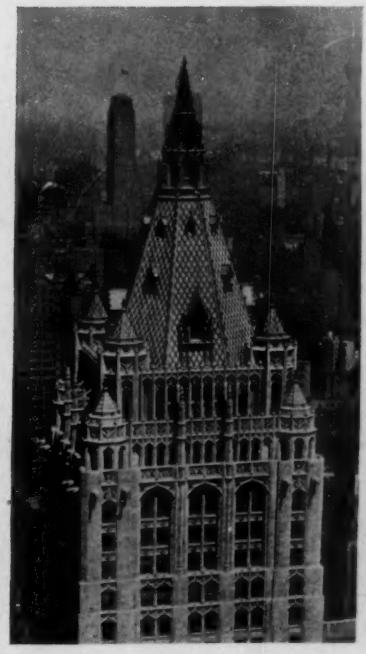
Casket of the Sleeping Beauty rests on the mountain top, serene above the White Way's racketeers. May the princess never cough up that bite of apple! Bush Building in West 42d Street.

Pyramid from Egypt, the highest in the world, became the cap of the Bankers' Trust Building in 1912. This gave another spur to decorating New York's skyline with startling designs.

Top of a Gilded Birdcage seems to me quite appropriate for the New York Central Building, apex of Park Avenue's luxury lane. Sight of it always sets me humming, "She Was Only a Bird in a Gilded Cage."



Cathedral of Commerce is the Lincoln Building in East Forty-second Street. So why should anyone be surprised to find at its top the loftiest of all church windows except those on the Woolworth?



Inverted Ice Cream Cone, of golden brown pastry, stamped in the Nabisco pattern, is the peak of the New York Life Insurance Building. (Where Diana once stood on Madison Square Garden tower.)

Man-Made "Giant's Causeway," with seven giant step-backs for seven league boots, tops the new building at 120 Wall Street. The pride of Ould Ireland in a great natural wonder is bound to suffer from this.

WHAT'S WRONG ENGINEERING

A SUGGESTED PROGRAM FOR IMPROVING THE CLASSROOM LECTURE

By Ernst A. Guillemin
Professor of
Electrical Engineering
Massachusetts
Institute of
Technology

IN recent years, various articles have appeared in the educational literature regarding novel methods of teaching which are designed to create more interest and enthusiasm in the student toward the subject under discussion, and in general contribute to an easier comprehension and eventual retention of the material presented. It seems to be the opinion of many educators that the so-called conventional methods of teaching have failed of their purpose, and that the time has come for the introduction of radical changes in procedure based upon careful studies of group characteristics. Any efforts directed toward the improvement of teaching methods are, of course, to be encouraged; but it seems to the writer that if the conventional method has failed in many cases it need not necessarily be due to the method, but rather to the way in which it has been carried out. Instead of taking all the trouble to invent new systems, it may be a good idea to try and remedy the old. If the instructor will bear in mind a few simple principles while carrying on in substantially the old fashion, he will find that the latter is not so bad after all.

One of the most important aids in holding the student's interest and attention is to make sure that he is at all times informed as to what is being talked about. This sounds foolish in a way, and yet it is quite a common occurrence in lectures that the student asks of himself or of his neighbor the question: "What on earth is he talking about now?" This situation often arises when some student asks a question of the instructor. The latter may know what the student has in mind, or at least sufficiently understand the question to be able to proceed with the process of answering it. This may sometimes consume five or ten minutes, which are usually of benefit only to the student directly concerned, while the rest of the class sits and wonders how long this meaningless harangue is going to last. The discussion is of no value to them because they did not understand the question that was raised originally. The instructor should first explain the question to the class and then proceed with the answering of it.

The presentation of a new phase of the subject should always be preceded by a fairly thorough discussion in the nature of an orientation process. In it should be sketched the method of attack and the reasons for using it, the physical side of the method and the result which may logically be expected, as well as its probable range of validity, according to various assumptions which must be made before an attack is at all possible. The presentation itself should follow closely the thought processes which must have been experienced by the person or persons who originated the particular method of attack. Very often we have no idea as to what these processes may have been, but in such cases it is the instructor's duty to reconstruct these out of his own experience or imagination. This phase may be called the "Sherlock Holmes element" in teaching. It is an important element and its value is quite generally disregarded entirely, especially in the writing of original papers. The writer of such a paper usually presents only the method in its latest stage of metamorphosis, and craftily submerges all the homelier preceding stages which, from the pedagogical standpoint, contain ten times the value as compared to the final "elegant" form. This kind of presentation may be justified in the periodical literature for economic reasons, but in the classroom as well as in the textbook such a process is inexcusable.

Elegance of form in a presentation belongs in the same category with mathematical rigor and generality. These things can be appreciated only after the subject is thoroughly understood. They have no part in the process of making the subject understandable. For this we need homely non-rigorous expressions and physical illustrations. The use of high-sounding mathematical terms should be particularly avoided, along with definitions of new technical terms. The latter may be men-

(*Continued on page 37*)

Professor Guillemin's statement of the appropriate attitude of an engineering teacher demonstrates the qualities which make him the admirable teacher which he is, as well as the excellent investigator and writer on his subject. His processes illustrate the thoughtful manner in which he approaches his teaching. It is necessary for an aura of resourceful constructive thinking and doing to emanate from the spirit of those who teach such classes as ours in order that the teacher may be effective in his influence on the students. It is not adequate for this to come alone from those who direct departmental affairs or those who confine their endeavors to formal research. Formal and external badges of learning, however carefully conferred, can not compensate for the deficiency of these qualities. Their effective development associated with the spirit of inquiry in the individuals of the staff, is one of the things which makes the Electrical Engineering Department of the Institute of high reputation in the engineering world.

February 20, 1932 **D. C. Jackson**

WITH MODERN EDUCATION?

A STATEMENT OF THE STUDENT POINT OF VIEW

By Beaumert Whitton '33
Editor, The Tech

The Tech

TO present a series of academical criticisms and complaints against the educational system as exemplified by the engineering schools is useless. But to show what faults and shortcomings are found by a student who participates in that system may result in improved conditions. This paper is prepared with this in mind from observation, a little experience, and a small amount of reading done in the ordinary course of events without an attempt to unearth the classical discussions of engineering education.

To even the casual observer, the first fact that becomes apparent is that there must be something wrong with the system of entrance requirements now in vogue. The high mortality rate among undergraduates of the first two years would indicate that something is amiss. At times it is almost pathetic to see the men who attend engineering schools and make the valiant effort to adapt themselves to work for which they are not fitted. If it takes these men a term or more to discover that they are unfitted for engineering, not only have they wasted their time and money but also they have occupied facilities that could have been used by others.

After men have been admitted to an engineering school, in general little attempt is made to classify them according to ability. Men of exceptional ability are placed in the same groups with those not so capable. The result is discouraging to both: the man who grasps the subject rapidly is disappointed with the slowness with which the material is presented, while the more dull man is discouraged because he cannot maintain the standard of work set up by the more capable individual — it being assumed that in the early stages of his college career a man has not reached the point where he recognizes the fact that men differ in capabilities, and that his P is just as creditable a record as the C or H of the more gifted man. That men are dumped into one hopper and selected at random to make up classes seems to be a complaint that may justly be made against the present system.

During the first part of his college life, the average student probably regards the instructor as a man who is paid to pour him full of knowledge. With this attitude, of course, he makes no effort to come in personal contact with the instructors. This may be quite fortunate, for later when he does realize that the educational system is not set up so that he can be pumped full of facts, he may attempt to establish closer relations with faculty members and find that there is no provision for such relations and apparently little hope of establishing them.

The matter resolves itself into this: there is little encouragement for the student to establish any closer contact with the instructing staff and even less opportunity to do so. Instructors are busy individuals who, under the present arrangement, do not have the time to devote to personal conferences. This seems unfortunate, for in many cases the personality of the instructor makes the interest in the course. His enthusiasm for the work, his ability to "put it across," his relations with the students are frequently worth more than the actual information imparted during lectures and recitations.

Some courses of a strictly lecture nature may be excepted if desired, but in general a closer relation between student and instructor would be for the better. With such relations established, the work would take on more interest and the subject become accordingly easier to master. A provision for conference with the instructor and the building up of an atmosphere where the student will consider the faculty member as an advisor instead of a demi-god who stands on a platform and spouts pearls of wisdom to be gathered as best one may, would improve the system. But mere opportunity for conference alone would accomplish little; the attitude between student and instructor should be one of beginner and advisor; the student must feel perfectly

(*Continued on page 38*)

As Editor-in-Chief of the present volume of *The Tech*, Beaumert Whitton has an unusual opportunity to observe the undergraduate attitude toward school affairs. At the request of *Tech Engineering News* Mr. Whitton has written an article which aims at constructive criticism of the present methods of engineering education. The purpose is not to criticise the Institute or any other engineering school, but to offer to students and faculty a frank critique of the system in general. The reader may thereby obtain a clear picture of the difficulties which the engineering school encounters. This new viewpoint, in itself, can do much to correct the existing situation.

— The Editor

The TECH ENGINEERING NEWS

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EDITORIALS

Graduate or Undergraduate?

One of the most significant announcements made by the Institute in recent months was that concerning the growth of graduate study and research at Technology. The facts are these: At the present time one third of all the graduate degrees in engineering are granted by the Massachusetts Institute of Technology. In certain departments, namely, Courses II, V-I, and X, one half of all the graduate degrees are granted here. These high percentages attest the reputation of the school and of the individual departments, but, more important, they show the increased emphasis which the departmental administration is placing on the training of graduate students.

It has been in the minds of many that eventually Technology would become essentially a graduate school, similar to California Institute of Technology. And the fact that post-graduate registration has increased so steadily, regardless of the temporary effect of unemployment, has seemed evidence to support this prediction. Regardless of the attitude of the administration, it appears that the personnel and equipment of the Institute is ideally fitted for the work of training graduate students. This in itself is sufficient to insure growth, but the preparation by the faculty to foster graduate work is bound to result in rapid progress and the eventual establishment of a large graduate school. Such a school, from the standpoint of scientific and industrial utility, is indeed a worthy object. But its effect on the undergraduate enrollment is by no means clear.

Two alternatives appear to be possible. Either the undergraduate school will be overshadowed, and the young preparatory school graduate forced to go elsewhere to obtain the essential fundamental training, or the scope of the engineering school will be enlarged to include both undergraduate and graduate training in a single course of increased length. The last alternative seems to be the ideal solution.

Before long we may see the beginning of the six-year engineering course. When it comes, the engineering graduate will be better fitted, not only to serve society, but to serve himself, both financially and culturally. If our increased graduate enrollment means that we are coming to such a state of affairs, here we have evidence of real progress.

Tact and Criticism

Little do most of us realize the effects of an institution such as Massachusetts Institute of Technology upon our natures. The average freshman arriving at Tech is in the plastic stage, so to speak, and the effects of the next four years have a deep and lasting result. A striking example of this impressed influence is the development of the critical attitude which is so common on our campus. Discarding the impression of a Tech student as a serious-minded, conscientious, unathletic being, leading his life for study, let us see if this hypothetical being is not critical to the point of crudeness.

Any course at Tech is a series of analyses from which we are to derive logical conclusions. Scientifically this critical analysis is all right, but it is too often, and erroneously so, carried over into the social world, where

it tends to produce strained and unpleasant relations. No human being is perfect, and we must learn to control our criticisms and handle situations with a great deal of tact.

Examining the successful men of science we find that although they, too, analyze humans, they have had experience enough to realize that no human being can be reduced to an exact equation. Consequently they keep their criticisms and deductions, for the most part, to themselves. This is what we as young men must realize. We must treat human criticisms as hypotheses and not as laws. We are endowed with two eyes and ears but with only one mouth. If we can learn to control our crude and often unwarranted criticisms, one of the most commonly noticed faults of the Tech man will be removed.

Faculty versus Student

In this issue of TECH ENGINEERING NEWS we have brought before our readers two articles on the same subject written by representatives of the two major contestants in the battle of getting "larnin'." The subject was put to both writers in the form of a question: "What is wrong with the present methods of engineering teaching?" Mr. Beaumert Whitton, champion of the student cause, went into the subject deeply, and found many things amiss. He admitted that he could suggest nothing in the form of remedies for the observed defects, except the effect of time. Professor Guillemin, who took the professorial point of view, chose to suggest a program. He weighed the average lecture and found it wanting. Whereupon he risked the censure of his confreres by suggesting what the lecturer could do about it. His program seems to us to be so straightforward and practical that its immediate adoption by the faculty would be a good start toward real student-faculty coöperation.

The two articles are typical of the problem as it exists in most educational institutions. The students can see many faults in teaching methods, but because they lack experience they cannot suggest practical methods of overcoming these faults. The members of the faculty, who are in a position to devise and apply the remedies, too often are not aware of the exact nature of the trouble. Manifestly, what is needed is less self-consciousness on the part of the student and a more receptive attitude on the part of the faculty. The student must be frank in stating constructive criticism; the instructor must be willing to assume the student's point of view. Most important of all, the greater experience of the teacher carries with it the responsibility of planning and applying the practical solution to the problem. We sincerely hope that the views expressed by Student Whitton and Professor Guillemin will be read and their suggestions adopted.

The Grasshopper and the Ant

Gone is the unthinking optimism of yesteryear. In these gloomy times the opportunity for self-appraisal, for lessons learned in the hard school of necessity, is golden. We who are hoping to be engineers, perhaps executives some day, should do well to resolve to guide our enterprise by sound economy.

The fable of the grasshopper and the ant seems most appropriate to the present international situation. France, a nation noted for her thrift — parsimony, said the wise ones in 1929 — has under one million unemployed, a well-filled treasury, the greatest per capita wealth of any nation and a splendidly wide distribution of capital. Like the ant, who had no fear of hunger when winter came, France is now in an enviable position as compared with the grasshopper nations who danced in the summer sunlight. When we were expanding our production, confident of an illimitable demand, France was protecting every project with an additional reserve of ready cash.

In private affairs as well as public, the ancient fable strikes home. If we who stand on the threshold of careers in engineering or business or science can learn to love prudence, to court thrift, to be wary always of the Great Unseen, with courage tempered by foresight, "the world is ours and all that's in it."

GENEALOGY OF A THEORY

***Suggestion*, an eager boy, met**
***Credulity*, a winsome maid, and begat**
***Plausibility*, an enchantress.**

Plausibility mated with a chance acquaintance, *Coincidence*, and bore him *Belief*, a stalwart youth.

Belief set out to conquer the World,
But across his shield
Was the bar sinister, for *Reason* had not consecrated the union of either
Of his progenitures.

—Bailey Willis

From *The Living Africa*, by Bailey Willis, Geologist and Explorer.

Dream Building

Castles in the air, castles in the sand; all of us have had them. But the castles of the future will be grander, perhaps, than any of our imagery. For if the architect and the engineer and the scientist combine, as they have in the past, there seem to be few limits.

Next generation's house will be a marvelous affair, according to Dr. Charles F. Kettering, a major research executive. The walls may be of wood composition or fiber or cornstalks. "It will have double windows with air spaces between the panes — and these windows will never be opened." Light conditions will be regulated by carefully manufactured panes of glass. Temperature and humidity, too, will be as much under our control as the modern electric light with its switch. "No more sticky, muggy summer nights — and no more of these dry, moistless winter days. And by turning a dial in the wall we shall flood this future house with exactly the light radiation that your body needs . . . the general health of the human race will improve as if by a miracle." In concluding his statement for the *Cosmopolitan* magazine, "Boss Ket" says, "Through television we'll have the whole world brought to our living room. The finest music and art will be ours for the turn of a dial."

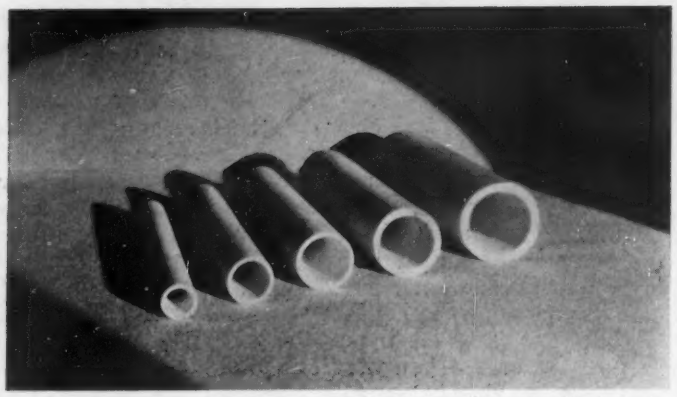
The opportunity is ours. Some of us will be architects, others engineers, still others devotees of pure science; and no mere handful, business men. Whatever we are, these houses of the future will be ours, with all their promise in brilliance of color and line and form: ours to make! As we stand on the threshold of Olympus, let us vow coöperation, fidelity, and courage. Our dream castles shall be realities.

Controversy

It is our policy at the present time to print each month on our editorial page our views on certain subjects of a controversial nature. Should you disagree with the ideas here presented or should you have any criticism whatever of the editorial material or make-up of this magazine, a letter from you expressing your views will receive our sincere appreciation.

ENGINEERING DIGEST

Condensations of outstanding articles in the leading trade and scientific journals, published by special permission



The Norton Co.

Science — What Is It? What Has It Done for the World?

Condensed from Scientific American, *January, 1932*

Dr. Arthur H. Compton, Physicist, speaks of science as simply an attitude that men may have toward the world. It is a desire to find how this outside environment in which we live, works, coupled with the desire to increase one's power to control it. It is an attitude that looks at life, determines its methods of operation, and adjusts them, so far as possible, to human needs. It is a comparatively recent idea, founded upon the belief that the world is reliable in its operation, a view that was not widely current two hundred years ago, and a view which takes us away from the old conception that "things just happen," or that very persistent belief that capricious and whimsical gods dispose of men and events according to fancy.

Many very sincere scientists, in their endeavor to simplify the universe, overlook the subtle but rich implications of the idea of science for the matter of living. Science, viewed broadly, is more than a matter to test tubes and electrons. Fundamentally it is a discerning approach to the problem of living satisfyingly in an environment of materials, men, and events that do not of themselves conform readily to our desires. It is a search for truth.

Leonardo da Vinci was one of the first consciously to develop this point of view. Galileo, Lavoisier, Newton, and a host of others should be permanently great names in our history, for they made significant contributions to the extension of this way of looking at life and things.

What has Science done for the world? To answer such a question is an enormous task. Surely it was largely responsible for the industrial revolution which has altered the lives of people. It has made it quite an easy task for man in the western world, where the idea of science has been fostered, to quickly overtake and surpass his eastern brother in the race for civilization. Virtually everything we touch is, in part, due to scientific investigation. Developments and advancements in all the fields of engineering, in chemistry, physics, and medicine, have resulted from the work of patient men embodying the truly scientific attitude. So it seems reasonable to take the point of view that the advance of civilization and the hope for its future are in Science.

Light and Water at Play

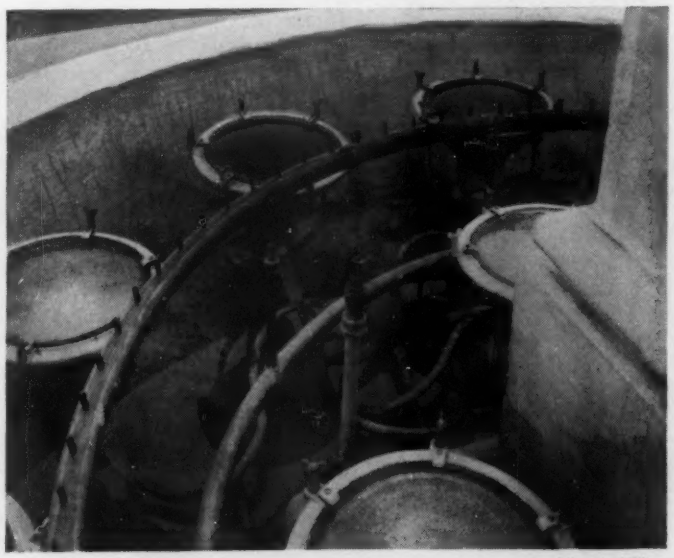
Condensed from Electrical West, *December 1, 1931*

Electric lighting and the science of hydraulics are today working more and more closely together. Fountains illuminated with multi-color floodlights are attracting attention in many cities. Beverly Hills, California, has recently installed an automatically-controlled display of unusual beauty and unique technical features.

The fountain proper is in the center of a large splash basin, and its base is illuminated by a dozen floodlights fitted with green lenses and mounted beneath the surface of the water in the surrounding basin. Sixteen other projectors, equipped with red, amber, green and blue lenses, are mounted in the top basin of the fountain proper. Their beams are directed upward on the streams and sprays of water, which at times climb to a height of sixty feet above the pool.

Technically considered, the fountain is of interest in many respects. As all the floodlights are operated under water, they must be strictly water-tight. Paradoxical though it may seem, this means that there must be a vent in each lamp housing, connected to atmospheric pressure. Otherwise, the tendency of the air inside the projector alternately to expand and to contract, as the unit is turned on and off, would cause water to make its way into the lamp — a phenomenon known as "breathing." To supply the floodlights with atmospheric pressure and to drain them of any moisture which may leak in, each lamp is connected by means of a lead pipe to a junction box, the bottom of which is open.

The variations in both water and lighting effects are governed by a motor-driven controller. Ten distinct color schemes combine with six water effects to give a total of sixty different spectacles in eight minutes. Although the fountain ordinarily operates automatically,



Section of the fountain proper, showing relative positions of jets, spray ring, and five of the twenty-eight floodlights.

Electrical West

manual control is provided for in a remote control station. Time switches in this station start the water effects at noon each day, turn on the illumination at dusk, and shut down the fountain at midnight.

Railroad Signaling

Skimming through towns in the deep of night with only the recurrent "clickity-click" of the wheels traversing the scores of cross tracks and switches to remind him of the outside world, the modern railroad passenger hardly appreciates the vast number of precise instruments and the maze of levers, lights and cables to which he owes his safety. The handling of trains is a science which has arisen from necessity. If the activities of railroad trains are not maintained on an orderly basis, delays and accidents inevitably follow.

The first semaphore type of signal was designed and erected about the year 1841 at New Cross, England. Motion of the arms of this early kind of indicator was produced by levers or handles on the masts. This method, of course, made the presence of a man at each signal necessary for its operation. The introduction of wires, and later rods or pipes, allowed signals to be controlled from a remote point. Counterweights were also added to the arm to cause it to assume the "stop" position by gravity.

Early types of semaphore signal were of the lower-quadrant form, the arms being displayed to the left of the mast in England and on the Continent, where left-hand running is the practice; and to the right of the mast in America, where right-hand running prevails. The "smashboard" stop signal of 1860 was an example of the lower quadrant type. A loud crash and flying splinters of wood told the startled engineer that he had ignored the clumsy red board hanging over the track at the level of the headlight. About the year 1903 the upper-quadrant semaphore was introduced; it is now the type most generally employed by American railroads. The use of semaphore signals as a whole, however, has reached a climax, since they are being steadily replaced by the light signal.

Light signals not only surpass semaphores in suitability for night operation, but also, when constructed with precision, they can be seen farther in daylight. Originally most of the effort was centered on illuminating the semaphore arm to make it visible at night rather than on making the colored lights visible during the day. The limitation of oil lamps was the underlying reason.

With the advent of electricity and with the invention of the incandescent lamp, renewed efforts were made to solve the problem of uniform day and night signaling. Also the necessity of signals for tunnels and subways began to present itself and a light signal was developed to take care of an installation that was being made at the time. The signal produced had no movable arm to change the color of the roundel in front of the light. Instead, individual lamps were placed behind each colored lens in order to give the various indications. While these were originally used in tunnels and subways, it was soon found that by using lamps of sufficient brilliancy and proper lenses, reflectors and background, light signals could be seen in daylight as well as in darkness. From the fact that light signals required no moving parts other than relays controlling the different lamps, it was soon recognized that they held a distinct advantage over the inefficient semaphore with all its motors, cylinders and levers. Within the last few years light signals have seen material development and extensive use. In fact, a number of railroads are installing nothing but light signals for new work and replacements.

Along with the development of signals has come the application of many mechanical safety features to railroad operation. Interlocking systems make it impossible to throw the track switches in a railroad yard except in a certain predetermined order, thereby preventing disastrous wrecks. The automatic block system, in which a train leaving one section of track and entering another throws a relay which in turn operates signals and bells, is now in universal use. Most recent of all is the automatic train stop, which prevents an engineer from carelessly running his train past a stop signal. A ramp, electrically controlled, projects up from the track and strikes a contact shoe on the engine as it passes; this in turn applies the air brakes of the train and brings it to a halt. Thus today's railroads put science to work in guarding the safety of their passengers.

The motor-driven controller and magnetic switches governing the light and water effects is housed below the fountain.

RESEARCH IN REVIEW

THE DEPARTMENTS

I. A two-mile stretch of the Connecticut River has been taken, in miniature, into the River Hydraulic Laboratory, for detailed study by Prof. K. C. Reynolds. Important result: plan for preventing erosion of the highway at Indian Hill, near Northampton, Mass.

II. Water-vapor bubbles exerting terrific pressures are formed in a stream of water when it is projected from an orifice into a restricted passageway of the correct shape. Equipment for the study of this phenomenon is now being installed in the Steam and Hydraulic Laboratory, in Building Three.

VI. The individual droplets of which fog is composed have been measured and photographed at the research station of Technology, at South Dartmouth, Massachusetts. This accomplishment, the first of its kind, was performed by Henry G. Houghton, a research assistant in Course VI, as a part of the program of experimentation with the transmission of light through fog as an aid to aerial and nautical navigation.

VII. A new cure for rickets has been developed by Prof. John W. M. Bunker and Robert S. Harris, after a year of experimentation. The new cure differs from former ones in that it contains no oil, has no connection with ultra-violet light.

VIII. The Physics Department was host to The American Physical Society and The Optical Society of America on February 25, 26, 27. Important announcements were made in papers read by leading physicists.

THE FACULTY

VIII. Dr. Joseph C. Boyce, an associate of Pres. Karl T. Compton at Princeton, has come to the faculty as research associate in the Department of Physics. His work will specialize in spectrographic analyses, in the newly opened spectroscopy laboratory.

GRADUATE

A partial list of the research now being carried on, as approved graduate theses:

VI

G. B. Hoadley: A Uniform Linear Light Source, and a Uniform Photoelectric Cell.

W. M. Hall: An Investigation of Sound Fields in Regions Restricted by Finite Boundaries.

Hugh M. Nazor: The Investigation of Thermal Breakdown of Glass Over a Wide Range of Thickness.

G. H. Fritzinger: The Development of a Vacuum-Tube Wattmeter Type of Harmonic Analyzer.

C. B. Basinger and H. L. Richardson: An Investigation of the Laws of Transmission-Line Conductor Vibrations which may have an Electrical Origin.

A. D. Bertolett, K. R. Bolles and C. F. Machen: The Degree of Approximation in the Values of Short-Circuit Current and Voltage for Relay Settings as Computed by Conventional Methods.

G. E. Carter and J. J. McNiff: Excitation of Synchronous Machines by Means of Thyratrons.

H. A. Danforth: Mechanical Force and the Mutual Inductance of Two Concentric Cylindrical Transformer Coils, Slightly Displaced Axially.

D. M. Goodman: A Study of Multi-band-pass Derived-Type Filters.

R. W. Hamilton: The Effect of Field Transients on the Pulling-into-Step of Synchronous Induction Motors.

Don N. Higgins, Jr.: Cycles of Operation in Modern Central Stations of Late Development.

G. F. Meyer: Some Operating Characteristics of the High-Frequency Induction Furnace.

J. E. Mulligan: Power System Frequency Control with Economical Distribution of Load Among Generating Units.

A. L. Nylander: The Effect of Ionizing Radiations on the Breakdown of Solid Dialectrics.

R. R. O'Leary: The Unpolarized Resistivity of Mica.

D. B. Sinclair: The Magnetron-Type of Vacuum Tube as a Frequency Doubler, and an Investigation of its Action with Plate Modulation.

L. A. Schuttig: A Study of the Effect of Tube Parameters on the Frequency of Oscillation of the Magnetron.

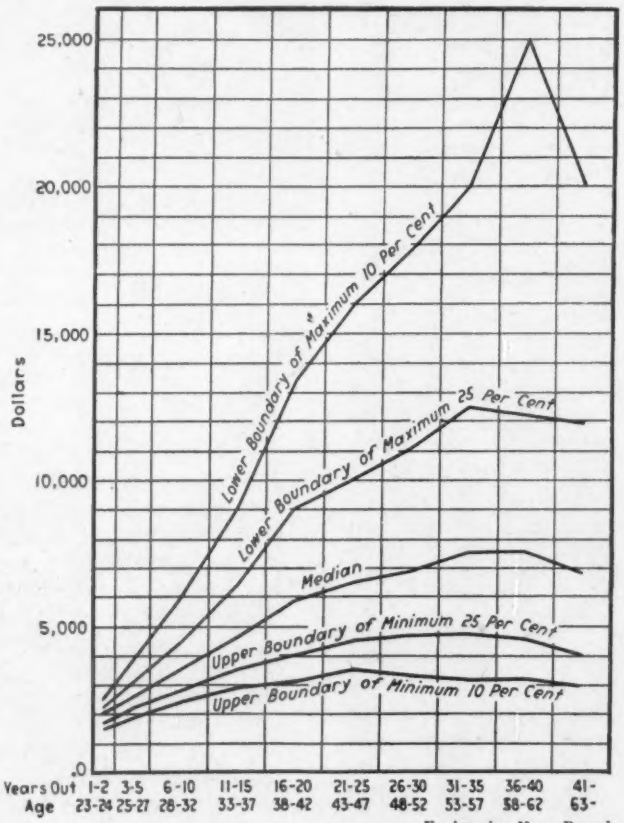
C. B. Seibert: Dynamic Torque Measurement.

XIV

F. C. Jelen: An Investigation of the Deposition of Chromium upon Zinc and Zinc-Base Alloys.

A. F. Kaye: The Electrolytic Oxidation of Molybdenum Anodes.

L. B. Johnson: A New Method of Obtaining Resonance and Ionization Potentials by Means of an Oscillograph.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Years Out 1-2 3-5 6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-
Age 23-24 25-27 28-32 33-37 38-42 43-47 48-52 53-57 58-62 63-

Engineering News Record

A graphic picture of what engineers earn, based upon their years after graduation and their comparative age.

UNDERGRADUATE

A partial list of approved undergraduate thesis subjects:

X

J. D. Abbott: Influence of Temperature on the Exhaustion of Various Dyebaths.

G. Amerman: Distillation Equilibria at High Pressure.

T. H. Anderson, Jr. and F. S. Chambers, Jr.: Low Temperature Catalytic Oxidation of Carbon.

E. F. Anderton: Rectification of Complex Hydrocarbon Mixtures.

J. C. Barousse: The Absorption of NaOH by Flax Cellulose.

J. A. Bellizia: Flow of Fluids over Flat Surfaces.

R. T. Billings and L. W. Bailey: Fluid Friction in Pipe Fittings.

J. J. Brown and C. R. Ingram: Counter Flow Partial Condensation of Hydrocarbon Mixtures.

M. Castleman: Low Temperature Evaporation of Binary Mixtures into Air.

J. P. Fahey: Electrodialysis of Limed Hides.

F. W. Fraim and D. M. Kentro: Ammonia Catalysts.

T. R. Freeman: Stress-Strain Determinations of Rubber.

D. B. Gilman and E. V. Buckley: Use of Electrical Condensers as Pressure Gauges.

H. B. Green: Fluid Flow through Rectangular Conduits.

L. Glickman: Variability in Breaking Strength of Rubber.

W. A. Hall and R. V. Wallin: Corrosion of Copper.

W. Holst, Jr.: Crystallization of Paraffin Wax.

J. G. Howe and W. F. Walsh: Study of the Coagulation of Rubber Latex.

S. K. Java: Study of Hydrolysis of Seed Oils.

J. T. Kelton: A Study on Interior Ballistics.

A. D. King: Supersensitive Panchromatic Film.

W. A. Kirkpatrick: The Effect of Solvation on Water Leaf Papers.

C. E. McCormack and D. Neilon: Transfer of Heat Through a Horizontal Plate to a Boiling Liquid.

E. C. Pfeffer: Reactivity of Various Forms of Cellulose to NaOH.

O. W. Rash, Jr.: Adsorption of Water by Anthracite Coal.

M. Richmond: Interfacial Films.

N. E. Rothenthaler: Fugacities of Hydrocarbon Vapors at High Pressures and Low Temperatures.

(*Continued on next page*)

LECTURES

(*Continued from page 30*)

tioned in a casual sort of way after their significance has been discussed at length and is thoroughly understood. Elegance, rigor, and thoroughness as well as an appreciation of the more general significance of fundamental principles are, of course, very desirable traits to develop, but these matters should definitely be brought up in a supplementary manner. In that way only will their true value be appreciated.

Another difficulty which the instructor frequently experiences in making his class-work more effective is due to a lack of response in the matter of questions from the students. Having completed his discussion of a certain phase of the subject, he welcomes or calls for questions on certain aspects which may not be clear. In many cases no response follows. This is usually due to the fact that the students are so bewildered as to be unable to form an intelligent question, and they are diffident about raising one which sounds foolish for fear that they will be exposed to the general amusement of the rest of the class. This sort of situation should be counteracted from the start by making it clear to the students that "foolish questions" will be welcomed, and that every attempt will be made to discover what the student is really driving at. In this connection it sometimes occurs that the only request that a student can frankly make, is to have the instructor begin all over again and repeat the presentation. Even this request should be complied with if it comes from a student who represents the class average in intelligence. It may be argued that this sort of procedure will materially impede the progress that can be made. But, after all, progress can be made only on an adequate foundation.

An additional factor which helps to gain the student's coöperation in the general process of interchange of ideas is frankness in the matter of answering questions which may be raised. It is perfectly possible that the instructor may not be able to answer a pertinent question at the time it is asked. In that case it is much better to admit that the situation is puzzling and that it will require more deliberation than can be given it in class. It is no disgrace for the instructor to admit that he does not know the answer to every question that may be raised in connection with his subject.

Finally the selection and arrangement of material in the presentation of a subject is largely a factor in determining its effectiveness. A disregard of this fact is quite commonly in evidence in textbooks. It seems that some authors are so anxious to exhibit their knowledge of certain impressive-looking mathematical bits, that they insist upon inserting them regardless of whether they have any bearing upon the subject or not. The only justification for considering various mathematical methods lies in their indispensability to the successful development of the subject. If they are not made use of later on, they should be left out altogether. Preferably they should not be introduced into the discussion until a definite need for them has been indicated.

RESEARCH

(*Continued from page 36*)

R. B. Semple and L. M. Burr, Jr.: The Effect of the Rate of Loading on the Compression of Copper Pressure Gauges.
A. T. Stockwell: Investigation of the Micro-Analysis of Yarn.
C. W. Ziegler and M. Ulloa: Solubilities of Oils in Organic Solvents.

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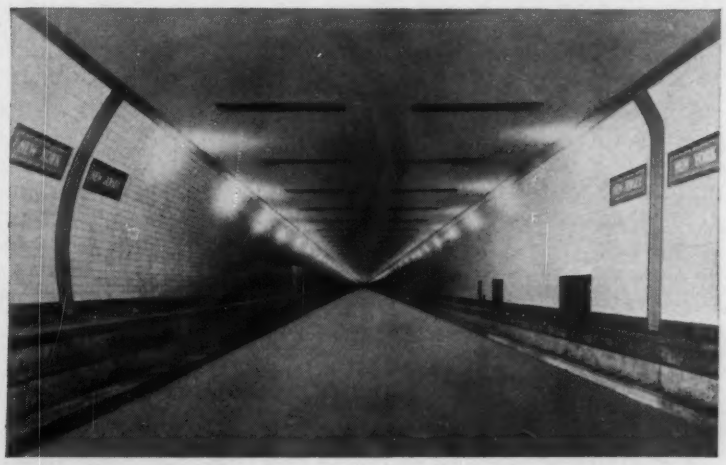

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STUDENT VIEWPOINT

(*Continued from page 31*)

free to call upon the instructor for help. The very prevalent idea among undergraduates that one is "booting" for a grade when he has an extra conference should be broken down.

Such relations cannot be built up in a day, nor in a year. It is something that must grow, slowly yet with force, and with its force displace the estranged relations now existing. How it should be done, I am frank to admit I do not know.

Probably the greatest indictment of the modern collegiate system is that it fails to provide an incentive to study. It appears that only one's determination and the realization that it costs good money to attend classes forces one to do the work. Admittedly one is in school to learn, but what inducement is there to learn? Little or no recognition is made of good scholastic work, and the college man finds it difficult to see the relation between scholastic work and success in after life, if there is such a relation.

Instructors somehow fail to put the spark of enthusiasm into their classes, and one must admit that the work in the earlier years is far from inspiring to either instructors or pupils. If and when one becomes interested in his work, it immediately becomes easier and more enjoyable. If it were possible to inspire every student a great step would have been taken. Just now it appears impossible of attainment, but with the almost total lack of effort made to induce the students to do good work, something should be possible. The problem as to how one should proceed in this case is indeed a baffling one.

There is always the complaint that certain courses of study are too specialized and that others are too general or contain too much theory. In liberal arts courses such complaints are relatively few, but in engineering they are always with us. Twenty years or so ago, I believe, there was a great hue and cry from the practicing engineers for men who understood the detailed technique of the various positions they were to occupy after graduation. Then followed a period during which considerable portions of the engineering curricula were devoted to specialized subjects. In recent years there has been a tendency toward the other direction. Practicing engineers are asking that students be taught the fundamentals of the work, and colleges are giving this preparation. Always a balance must be struck between the amount of theory and the amount of practical work offered.

Some schools are attempting to give more and more of the basic training on the assumption that the practicing men know the need of the engineer. But even so there remains the call for graduates who, having finished their technical education, are able to take their places in industry without a period of training that must be given to those men who have received solely a theoretical education. That this call exists is shown by the fact that some schools are attempting to crowd into four years all the theory and some of the practical material. In such cases the student is usually overworked, but it must be remembered that a capable student interested in his work is able to do almost as much as he wants to, within limits, of course.

Some courses are too theoretical, neglecting the practical side entirely; others are too practical, devoting too little time to the fundamentals. Some strike a happy medium; each must choose for himself which are the successful ones. The criticism arises from those that have too much of either the theoretical or the practical.

Further criticism may be raised because in the majority of engineering schools there is so much technical matter to be crowded into four brief years that little attention is given to the more liberal studies. Where such courses are appended to the regular engineering curriculum, they are generally concentrated in the first two years, whereas if they are to be of the greatest value to the graduate they should come in the period immediately preceding graduation. Where the liberal work is spread over four years, there is so little time for it that the students regard it as a minor matter to be given scant consideration when laying out a course of study. By concentrating the study of more liberal subjects on the first years the value is lost; by spreading it thin over four years its value is lost to the student unless he takes it seriously. Some other arrangement might be of more value.

There is always the complaint that men who have graduated from technical schools have been in an artificial environment where they are out of touch with the world and its problems. They have been in contact with students having practically the same aims as themselves and professors who have taken a kindly if unshown interest in their welfare. After graduation, they enter a hostile, aggressive world where every man must stand on his own merits. The college man lacks contact with this world; the educational system should attempt to supply it. Some courses of study furnish this contact through the coöperative work, but the majority do not. In most cases coöperative work would be a valuable adjunct to the course.

From this presentation it might seem that the picture of the educational system is completely dark: entrance examination methods are open to criticism,

(*Continued on page 40*)

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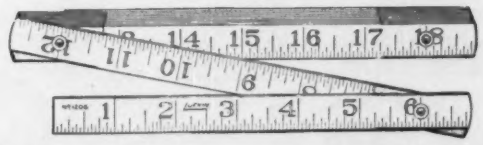

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ACCOUNTING

(*Continued from page 27*)

concerned with cost accounting and statistics. Cost accounting refers to that department of accounting which has for its purpose the ascertaining and recording of the actual cost of making things through the various steps in the process. It also determines for the management those control figures which help the factory to know whether or not they are operating efficiently. It concerns itself with special problems: Why a certain operation is showing such a great loss? Is it due to the method of calculation or is it real? Should we spend a sum of money in cutting down loss or wastage and how much could be saved? Why does one operation cost less at one plant than at another? Could we manufacture more efficiently and at less cost in another location? Does a newly developed process give evidence that it will cost less than the present one? Cost accounting is perhaps the least understood of the many subjects relating to accountancy. It is also considered one of the most difficult subjects, particularly because of the trouble experienced in applying accounting principles to meet the variety of conditions found in connection with different manufacturing processes and establishments. It can readily be seen that cost accounting requires a thorough knowledge of manufacturing details as well as a thorough knowledge of accounting. This department offers the best chance for the beginner to build a foundation.

The fourth road approaching the comptrollership is by way of the general and home office accounting department. This department may be very complex in a large organization with many branches or very small in a single factory concern. The duties of this department are as follows:

1. General ledger where all the transactions of the business are finally recorded in summarized form and which controls the subsidiary ledgers.
2. Financial statements and schedules including:
   (*a*) Balance sheet.
   (*b*) Profit and loss statement.
   (*c*) Cost of sales.
   (*d*) Expense schedules.
   (*e*) Sales schedules by products, territories, etc.
3. Tax problems.
4. Tabulation of sales in various ways.
5. Audit of subsidiary records.
6. Summarizing information from branches.

This brief resumé of the four main accounting roads leads to a more complete consideration of the question. Is the engineer better fitted by training than any one else to become a successful comptroller or vice-president in charge of finance? Successful accountants will always continue to come from many different beginnings and perhaps the most successful of all may come from among those whose training has been from the school of experience and hard knocks alone, supplemented perhaps by home study. However, there should be one kind of training most suitable for producing the greatest average of successful accountants and those who can best improve the rating of accountants as a class in the eyes of business heads. It is the writer's opinion that an engineering training supplemented by accounting fundamentals acquired through any good commercial engineering course, in a post graduate course in college or in public accounting work is the best foundation with which a person may compete for the high positions in the financial or accounting section of any business. And I might say that if a thorough knowledge of all branches of the business count for anything, the comptrollership — other things being equal — should be the best place for which to look for candidates for the higher positions of president, general manager, or other general executive positions.

The basis for this opinion is as follows:

The engineer by reason of his training is wonderfully qualified —

1. To know the significance of figures.
2. To know how to get all the facts in any problem and to know how to analyze and weigh those facts in order to arrive at a common sense solution.
3. To understand the scientific background of manufacturing operations both mechanical and chemical as well as the theory and practice of accounting and therefore to be in a position to coördinate manufacturing with accounting in a common sense, practical, and understanding way and to interpret the cost and financial figures in a simple yet direct way to the management.

It is recommended that the cost department be the starting place in any concern to train for comptrollership. There is no department that gives one such a broad and yet detailed view of the whole manufacturing and accounting structure. The cost accountant deals with the plant engineer on matters of measuring devices for recording materials used, factors for distributing the cost of steam, electric power, water, etc., to the various products; deals with the superintendent on costs of all operations, losses, wastages, operating standards, etc., deals with the general accounting department in providing them with accurate inventories and other fundamentals for the calculation of the general books of account, and deals with the sales department in furnishing them with accurate factory and selling costs to enable them to intelligently establish selling prices.

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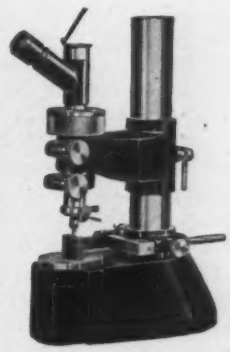

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SOURCE OF LIFE

(*Continued from page 26*)

spinning motion to its far-flung particles. Under either theory, the star left the scene of the accident without making itself known and is lost in the limbo of hit-and-run motorists.

Some day we may develop an acceptable collision-theory; but those who have worked upon the problem have made so many errors that the idea is at present not only unproved, but improbable. This does not mean that we are thrown back upon the theory of tidal disruption as the "residuum" which Sherlock Holmes tells us must contain the truth; for it's better science to admit that we have no acceptable theory than to proclaim one that hasn't been cleared of major objections.

Trying with what means are safe, to reconstruct the solar history of the earth, we may believe this much: that the earth surely came from the sun; the earth brought away a good inheritance of solar heat, and at first squandered the heat in trying to warm up interstellar space; that when a blanket of cool rocks covered the outside of the earth, the loss of heat became much slower, until its rate is almost negligible. Upon the blanket of cool rocks, the seas became cool, if indeed they had ever been hot; and in sun-warmed, shallow water, rich in solutions and colloids, the first life began. And all this was long before the oldest rock formations *which we now can see*, were made; all this was long before thirteen to fifteen hundred million years ago.

DIGEST

Bermuda's Horizontal Well

Condensed from Scientific American, *March, 1932*

Naturally filtered, fresh water in Bermuda was made practicable on December 30, 1931 when the construction of a horizontal well system was completed. The project was planned and directed by Prof. W. D. Turner, of the Department of Chemical Engineering at Columbia University. For generations residents of the island have obtained water from rain caught on the house tops. This was obviously unsanitary. The problem facing the engineers, then, was to supply a maximum amount of pure water without drawing salt.

A suitable hill having been selected, a tile drain was laid in a trench along its foot. The level of this trench was carefully made six inches above mean high tide and about eighteen inches below the fresh water level within the hill. [This fresh water level is caused by rain water which, after falling on the upper slopes, seeps down into the coral structure of the hill.] The joints of the pipes were left open to catch rain water reaching them. The trench was finally filled and packed with coral sand.

Briefly, rain water, amounting to three hundred thousand gallons per day, filters through the porous coral rock and sand and is then captured and prevented from seeping into the salt marshes, thence reaching the ocean by the action of the tide.

STUDENT VIEWPOINT

(*Continued from page 38*)

the practice of making no distinction between men of varying ability is a poor one, student-instructor relations are not all they should be, lack of incentive to study appears deplorable, the question of too much theory and too much practical work arises to plague the educator, the custom of concentrating the liberal work in the early years could probably be improved, and the failure of the system to provide contact with the outside world is a shortcoming.

But the picture is not entirely black; it is generally agreed that an engineering education supplies the fundamental training on which the specialized knowledge necessary for the various parts of engineering may be founded. As one educator put it, the purpose of the engineering curriculum is to "develop the innate powers rather than craftsmanship." The present system is doing this, and as evidence one has only to consider the number of engineers who later enter fields unrelated to that for which they prepared.

In answer to the complaint that the work is too specialized or too generalized, it may be said that engineering curricula are constantly undergoing changes; there is nothing static about them. As suggestions come in from practicing engineers the material presented in the courses is altered, and it must be said that what is offered at the present time is that generally considered the best possible by these practicing engineers and the faculty heads.

Because of the large mass of technical matter that must be presented in almost any engineering course, there is little time left for the more liberal subjects; and as it is generally thought that these subjects are more easily mastered by the engineer without professorial instruction than are the theoretical subjects, preference is given to these courses to the exclusion of the liberal arts work. Some provision is made for giving the student a touch of this liberal work, perhaps with the hope that it will arouse enough interest so that the student will devote time to it after graduation.

But despite these answers to the criticisms there still remain the faults and shortcomings of the engineering education as it now stands. Considerable thought is being given the matter, and as time goes on it is likely that changes will be made. Until then it appears that the undergraduates will have to bear with each other and the faculty, trusting that some day the faults will be corrected.

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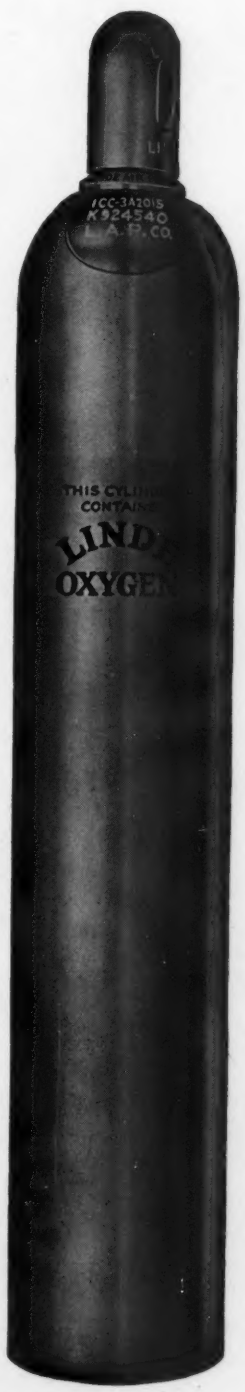

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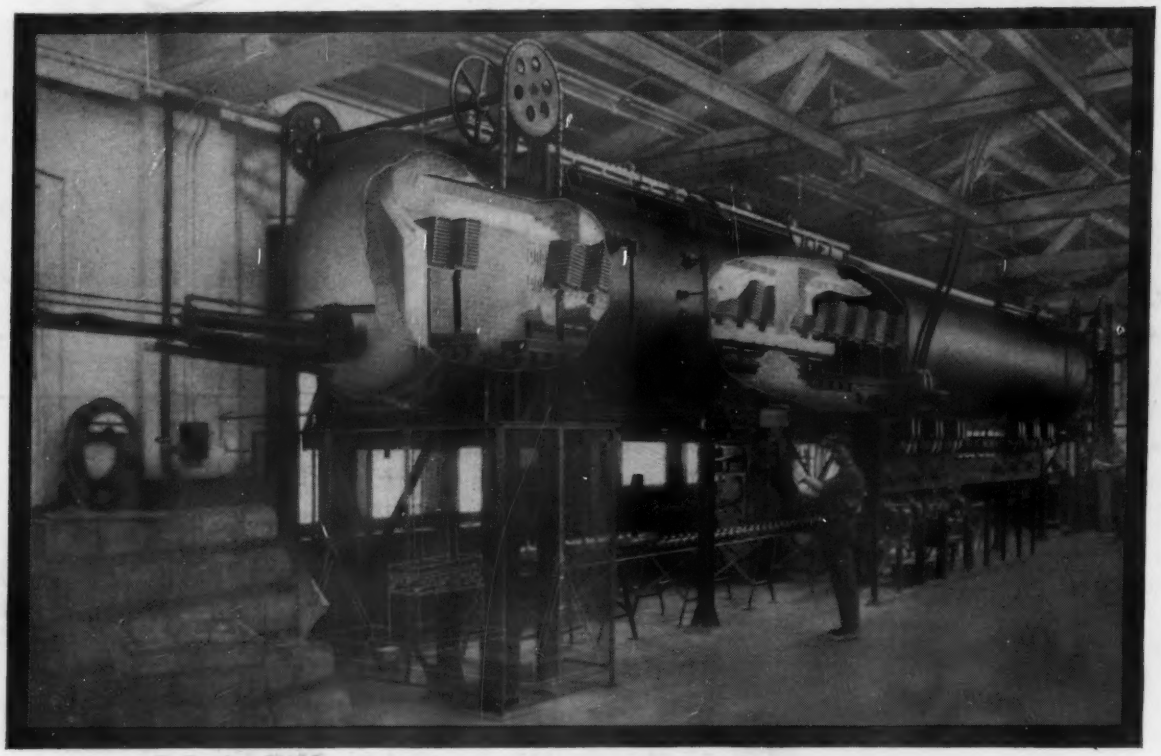

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